COURSE ON MISSILE DYNAMICS

Problems

A certain drone missile has the following data:

$W = 1{,}700$ lbs.

$S = 27.0$ ft.^{2}

$c = 2.42$ ft.

$b = 11.17$ ft.

$S_H = 12.4$ ft.^{2}

$\ell_H = 60$ ft.

$I_x = 85$ ft. lb. sec.^{2}

$I_y = 650$ ft. lb. sec.^{2}

$I_z = 700$ ft. lb. sec.^{2}

$\frac{dC_L}{d\alpha} = 4.7 \text{ rad}^{-1}$

$\left(\frac{dC_L}{d\alpha}\right)_H = 3.0 \text{ rad}^{-1}$

$\frac{\partial C_m}{\partial \alpha} = 0.3 \text{ rad}^{-1}$

$\frac{\partial C_y}{\partial \beta} = -1.7 \text{ rad}^{-1}$

$\frac{\partial C_y}{\partial \frac{pb}{2V}} = 0$

$\frac{\partial C_y}{\partial \frac{rb}{2V}} = 0$

$\frac{\partial C_\ell}{\partial \beta} = -0.14$ rad^{-1}

$\frac{\partial C_\ell}{\partial \frac{pb}{2V}} = -0.36$ "

$\frac{\partial C_\ell}{\partial \frac{rb}{2V}} = 0.26$ "

$\frac{\partial C_n}{\partial \beta} = 0.25 \text{ rad}^{-1}$

$\frac{\partial C_n}{\partial \frac{pb}{2V}} = -0.05$ "

$\frac{\partial C_n}{\partial \frac{rb}{2V}} = -1.00$ "

Calculate:

1. Period and damping of the pitching mode.
2. Period of the phugoid.
3. Period and damping of the Dutch role for the following conditions:

h	M	
10,000 ft.	0.6	0.75
30,000 ft.	0.6	0.75

Assume: for h = 10,000 ft. $\rho = 0.001756 \quad \frac{\text{lb sec}^2}{\text{ft}^4}$

$a = 1078$ ft/sec

for h = 30,000 ft. $\rho = 0.000890 \quad \frac{\text{lb sec}^2}{\text{ft}^4}$

$a = 995$ ft/sec